Crestron
Programming Design Kit
Instructions & Forms

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Contents

Introduction 1

Managing Expectations 1

Programming Software 1

Sound 2
Background Images 2
Bit Depth and File Size 2

Relationship of Bits to Colors 3

Touch Screens, Templates and Themes 3

Project Planning 5

Additional Required Information 5
Form A - Device Data 7
Form B - Interface Specification 9
Form C - System Routing Specification Instructions 11

Touch Screen Resolution Specifications 12

DGE-1: Digital Graphics Engine with DigitalMedia CAT Connectivity 13
DGE-2: Digital Graphics Engine with HDMI and DigitalMedia CAT Connectivity 14

Control System Block Diagrams 19

Crestron Engraver 20

Printer and Paper Requirements for Cutout Labels 20
C2N-CBD and C2N-CFB Series Engraving 20

Button Panel Specifications 21

C2N-CB Series Cameo Keypads Description 21
Form D - Cameo Keypad Specifications 22
Form E - C2N-DB6/8/12 Decorator Keypad Specifications 23
Form F - C2N-DBN12 & C2N-DBF12 Decorator Keypad Specifications 24
Form G - CNX-B2/B4/B6/B8/B12 Single Gang Keypads Specifications 25
Cameo and Cameo Express In-Wall Dimmers and Switches 26
Form H - Cameo and Cameo Express 26
CC2N-CBF-P Cameo Keypad, Flush Mount 27
C2N-CBD-P Cameo Keypad, Standard Mount 27
Form I - C2N-CBF-P & C2N-CBD-P 27
HTT-B10X and HTT-B10EX Tabletop Keypads 28
Form J - HTT-B10X 28

Lighting Control Interface 29

Converting Crestron Components to a User-friendly Lighting Interface 29
Form K - Lighting Control Programming Request - Keypads 30
Form L - Lighting Control Programming Request - iLux 31
Form M - Lighting Control Programming Request - TPS-4L Touch Screen 32
Form N - Lighting Control Programming Request - TPS-6L Touch Screen 33

Appendix A: Touch Screen Objects 34

Web Objects 40

Appendix B: Touch Screen Design Example 41

Appendix C: Color Theory 45

Light versus Paint 45
Color Properties 46
Color Perception 46
Color Harmony 47
Specifying Colors 50
Color Relativity and Readability 51

Appendix D: Touch Screen Typography 52

Typeface (Fonts) 52
Lower-case versus Upper-case Characters 54
Font Height (Type Size) 55
List of Typography Design Recommendations 57
Acknowledgements 57

Further Inquiries 57

Introduction

Crestron® connects people with technology. As products and systems become more complex, our touch screens and keypads streamline and simplify technology so people can fully utilize and enjoy its advantages. Crestron touch screens and keypads provide an intuitive way for people to interact with and experience the systems in their homes, offices, schools and churches. Using touch screens, individuals can create a comfortable environment, set a mood, and benefit from technology.

Managing Expectations

The key to designing a successful user interface is having a clear vision of the project, space, subsystems, the customer's desires and expectations — all of which dictate functionality. It is vital to know the functions to be controlled and have a clear vision from the end user regarding system use.

- Will the touch screen interface with subsystems such as lighting, HVAC, and security?
- How does the customer want the zones divided and controlled for lighting, audio, and video?
- Does the customer expect complex lighting, water, and climate control events and scenarios, or do they just want to turn lights on and off?

It is equally important to evaluate the level of technical sophistication that the end user possesses. The programmer must work within the customer's abilities while striving to meet expectations. If the customer is pushed beyond their comfort zone, then the system will be unappealing to the client, resulting in disappointment and/or intimidation. Managing expectations is extremely important and knowing when and why to say "no" is critical to the success of any given project. If there are too many buttons on a page, reorganize or reprioritize the subcategories to reduce the number of buttons per page. The number of buttons that can comfortably be positioned on a screen is determined by the physical size of the touch screens. Therefore, a more attractive, intuitive, easy-to-read and use interface is achieved with a larger touch screen. The ideal number of button presses to affect an event from anywhere in the GUI is one to three. Reducing navigation, button presses, and subpages for the end user makes the interface more useful and attractive. When designing a custom interface, start by talking to the customer about the décor of the room, corporate image, or favorite colors. It is essential to understand how the interface is intended to complement or match the client's décor and environment.

Programming Software

VisionTools™ Pro-e (or VT Pro-e®) is the Crestron Windows-based software for designing the page layouts and functionality of user interfaces. Controls are grouped together on "pages" and these control pages are organized and grouped together as a project. A typical page layout includes objects such as buttons and sliders that start actions and provide feedback to the end user. Pages can also include video windows, decorative graphics, background graphics, text and a variety of other objects. A "page flip" causes the screen to switch from one page to another when a button is pressed. Browser projects also support page flips to a URL, or even to a different section of the current (large) page. Subpages are similar in many ways to standard pages, in that they may contain buttons, text, graphics, etc. However, subpages ordinarily do not take up the entire display area. Instead, a subpage often defines a small area with buttons serving a specific function, such as VCR control. A subpage can be designed to appear on top of a standard page at any time and then disappear when no longer needed. VisionTools Pro-e software enables layering of objects on top of each other, allowing for versatile design possibilities. Objects are layered in the order they are created. That is, a newly created object will be overlaid onto an existing one, and if one object is dragged over to another, the more recently created object is visible on top. Refer to Appendix B for an example program.

Sound

The Vision Tools Pro-e Sound Manager enables the user to add WAV files to projects for sound-enabled touch screens and keypads, such as most TPS panels, and CNXB2/ B4/B6/B8/B12 button panels.

Background Images

VisionTools Pro-e supports BMP, PCX, DIB, and JPEG formats. Images can be modified to fit the page. The Tile option fills the space on the page with multiple copies of the image (This feature works best with smaller images). The Stretch to Fit option stretches out the image to fill the entire page.

Bit Depth and File Size

A bit depth refers to the number of memory bits used to store color data for each pixel in a raster image. A touch screens raster image consists of a rectangular grid of picture elements (pixels). Each pixel uses the same amount of memory to store its color data. The amount of memory is called the bit depth of the image.

Greater bit depths are required to represent finer gradations of color. Increasing bit depth necessarily increases file size. A black and white drawing requires only one bit per pixel to store all the available color information. Using a 32-bit per pixel bit depth for a black and white image increases the file size 32 times without adding anything to the black and white image quality.

In an 8-bit per pixel system, the associated 8-bits of video memory for every screen pixel contain a value referring to a location in an 8-bit color table. In this way any one of the specific 256 color table locations is assigned to a pixel.

A 16-bit highcolor system is considered sufficient to provide life-like colors. It is encoded using 5-bits to represent red, 5-bits to represent blue and (since the human eye is more sensitive to the color green) 6-bits to represent 64 levels of green. These can therefore be combined to provide 65,536 mixed colors (32 x 32 x 64 = 65,536).

In a 24-bit graphics display, the video memory allocates 24 bits for each pixel on the screen enabling each pixel to take on any one of a possible 16.7 million colors. Each 24-bit value is composed of 8-bits for red, 8-bits for green and 8-bits for blue. These triplets of 8-bit values are also referred to as the red, green and blue color planes. A 24-bit image is actually composed of three component images, which combine to create the truecolor picture. The reason this is called truecolor is that this is near the maximum number of colors the human eye is able to detect.

Truecolor images are sometimes represented by a 32-bit value. The extra 8-bits do not enhance the precision of the color representation but act as an alpha channel that represents pixel translucence. The 32-bit truecolor has become popular on the computer desktop to provide effects such as translucent windows, fading menus and shadows.

In graphics intensive applications such as touch screens, raising or lowering the color depth of the displayed graphics can achieve a balance of performance and quality. Lower color depths do not require as much frame buffer memory or display bandwidth, allowing them to be generated and displayed more quickly. Increasing color depth results in higher color quality at the expense of display speed and responsiveness. By using mostly 8-bit or 16-bit graphics and holding the 32-bit graphics to a minimum (e.g., for a family photo, etc.), a sophisticated project can be created that fits in the memory space provided and have the touch screen remain very responsive.

Relationship of Bits to Colors

Number of Bits	Number of Colors
1 bit	Black and White
2 bits	4 Colors
4 bits	16 Colors
8 bits	256 Colors
16 bits	65,536 Colors (Highcolor)
24 bits	16.7 million Colors (Truecolor)
32 bits	16.7 million Colors plus Transparency

When creating a VisionTools Pro-e project, elect to compress and reduce the image size in the “Page Properties” window for the entire page and/or perform the same function of reducing the image size using the “Image Properties” window. A reduction in image size saves a considerable amount of memory space for the project.

In VisionTools Pro-e, the Compress checkbox permits the image to be compressed when compiling. The 16 Bits checkbox converts a 24-bit or 32-bit image to 16 bits. This conversion to a 16-bit image may cause the loss of some subtle shading. To compensate for this, use the dithering to simulate the original shading. Various dithering types are available.

Touch Screens, Templates and Themes

Crestron offers a variety of pre-designed templates that are totally customizable to fit the project needs. The templates cover a wide variety of control requirements and provide the designer with a starting point for large or small projects.

The following are a few examples of the many possibilities that templates can provide. Refer to www.crestron.com/gui for additional template examples and icons.

In the VisionTools Pro-e software, a theme is a set of unified design elements and color schemes for the objects and pages in the touch screen project. When a theme is applied to a project, VisionTools Pro-e customizes attributes, such as colors, styles, fonts and shapes, for elements in the project. In this way a theme helps create a consistent and professional look.

With the Crestron Theme Library, there are themes that are designed for particular applications, such as Residential, Commercial, or Educational. Categorize themes according to general style, such as Traditional, Modern, Industrial, or Classic. Crestron provides several themes that are available on the hard drive when installing VisionTools Pro-e. Using the Theme Library, view or customize the Crestron themes, design, edit or delete themes.

The Theme Library organizes themes by touch screen type; all themes are available to any project of the same type, including projects created in earlier versions of VisionTools Pro-e. The Readme document contains a list of recommended fonts for use with VT Pro-e themes. Many of the fonts listed are included with Windows operating systems.

Touch Screen, Template and Theme Examples

Smart Graphics for Homes

Smart Graphics for Conference Rooms

Smart Graphics for Conference Room Demos

Smart Graphics for Room Scheduling

Black Glass Theme

Brushed Steel Theme

Project Planning

Planning the project carefully produces good results. This involves providing complete information on the required forms. This kit contains forms to fill in to define the project.

- Form A is a complete list of all equipment to be controlled.
- Form B defines the customer interface.
- Form C defines the routing of source to destination.
- Form D provides a method to specify button panel operation and engraving.

Additional forms are provided for lighting control.

Additional Required Information

A successful design requires complete information. Please submit the following documents, if available.

- System Block Diagram
- Control Diagrams
- Facility Plans and/or Other Layout Diagrams
- System Description
- Applicable Audio Files
- Applicable Graphic Files

Form A – Device Data Instructions

The initial task is data collection. Each device to be controlled must be listed according to type, manufacturer, model number, and control method (RS-232, IR, etc.).

For equipment that does not have discreet power on/off capability, specify additional video or current sensing equipment. Crestron maintains an extensive database of equipment control software, making it very likely that we have information on every piece of equipment in the project.

Use as many copies of Form A to collect and record this data as necessary. Be sure to fill in the heading on every copy.

Form A - Device Data

Project Name	Date
Order/Quote #	Page of

Type of Device Blu-Ray TV, CD, etc.)	Manufacturer (Sony, Panasonic, etc.)	Model Number (ex: AG-1350)	Control Method (RS-232, IR, RF, etc.)	Additional Current/Video Sensors (ST-VS, ST-CS, etc.)

Form B – Interface Specification Instructions

Determine the number of pages required for the project. Assuming at least one page for each device (Projectors, Plasma display, CD, VCR, etc.), pages for systems (HVAC, Security, etc.) and the Main page. Then print at least an equal number of copies of Form B.

Pages and subpages are unique and should not share forms.

Fill in the Project Name, Date, Touch screen Model Number (ex., TPS-4000), the Screen Name (ex., Main Page) and Location (ex., Home Theater Room), Order/Quote #, and number the page (ex., 1 of 7), on every page.

Form B - Interface Specification

Project Name		Date
Order/Quote #		Page of
Touch screen Model #	Screen Name and Location	

Object Type (Button, Slider, Gauge, etc.)	Object Label (Abbreviate as necessary)	Function/Device (Specify the function to control and the device to control)	Page Flip To... (Subpage Name, Main Page, etc.)	Color (RGB, Hue, Saturation, Luminance)

Form C – System Routing Specification Instructions

Form C is used to describe the routing of each source output to each destination input. Specify the source (DVD-1, VCR-2, Laptop, etc.) and the particular source output (Video-1, S-Video-2, Component Video, etc.).

- When an intermediate switcher is used, specify the device and the input/output ports (Video 1 IN/Video 1 OUT, etc.).
- The final destination device is noted in the last column; include the device name and the input port.
- The bottom of the form has an area for additional notes that can be used to further define how the system can be programmed for specific needs.
- Make as many copies of Form C as necessary.

Form C - System Routing Specification Instructions

Project Name	Date
Order/Quote #	Page of

Source Name	Source Output/Type	Switcher Device Name		Final Destination And Input Port
		Input Port	Output Port	

Touch Screen Resolution Specifications

Tabletop Touch screens	Screen Size (inch)	Resolution	Graphic Design Color Depth	Aspect Ratio
TPMC-V15-TILT and V15-TILT*	15	1280 x 768	24-bit, 16.7M colors	15:9 WXGA
TPMC-V12-TILT and V12-TILT*	12	800 x 600	24-bit, 16.7M colors	4:3 SVGA
TPMC-9	9	800 x 480	24-bit, 16.7M colors	15:9 WVGA
TPS-6	5.7	640 x 480	18-bit, 256k colors	4:3 VGA
TPMC-8T	8.4	800 x 600	18-bit, 262k colors	4:3 SVGA
C2N-FT-TPS4, QM-FTCC-TPS4, & QMI-FTCC-TPS4	3.6	320 x 240	16-bit, 64k colors	4:3 QVGA

Wall Mount Touch screens	Screen Size (inch)	Resolution	Graphic Design Color Depth	Aspect Ratio
TPMC-V15-WALL and V15-Wall*	15	1280 x 768	24-bit, 16.7M colors	15:9 WXGA
TPMC-V12-WALL and V12-Wall*	12	800 x 600	24-bit, 16.7M colors	4:3 SVGA
TPMC-9L	9	800 x 480	24-bit, 16.7M colors	15:9 WVGA
TPMC-4SM	4.3	800 x 480	16-bit, 64k colors	16:9 WVGA
TPMC-8L	8.4	800 x 600	18-bit, 262k colors	4:3 SVGA
TPS-6L	5.7	640 x 480	16 Bit, 64k colors	4:3 VGA
TPS-4L	3.6	320 x 240	16-bit, 64k colors	4:3 QVGA
V-24*	24	1920 x 1200	24-bit, 16.7M colors	16:10 WUXGA

Wireless Touch screens	Screen Size (inch)	Resolution	Graphic Design Color Depth	Aspect Ratio
MTX-3	2.8	240 x 320	16-bit, 64k colors	3:4 QVGA
TPMC-3X	2.8	240 x 320	16-bit, 64k colors	3:4 QVGA
TPS-6X	5.7	640 x 480	18-bit, 256k colors	4:3 VGA
TPMC-8X	8.4	800 x 600	18-bit, 262k colors	4:3 SVGA

*Refer to the Digital Graphics Engines (DGE-1 and DGE-2) on the following pages.

DGE-1: Digital Graphics Engine with DigitalMedia CAT Connectivity

A graphics engine for Crestron V-Panel™, the DGE-1 supports advanced touch screen performance, with a single video window and connectivity for one analog AV source. Designed for use with a Crestron V-Panel HD Touch Screen Display, the DGE-1 Digital Graphics Engine allows for a very streamlined touch screen installation by placing the bulk of the electronics at the central equipment location. Mounted within an equipment rack, the DGE-1 connects directly to the head end AV sources, switchers, and control network, while the V-Panel display can be up to 200 ft away with just a single cable between them.

The DGE-1 features: 24-bit graphics, with single-window video display, embedded PC applications and Web browsing, streaming video and audio, and IP Intercom. Connectivity includes one composite or S-Video input, balanced stereo audio in/out, Crestron Home® CAT5 Balanced Audio, Cresnet®, and high-speed Ethernet. A DigitalMedia™ CAT output provides the connection to the V-Panel display.

Gestures Navigation

Adjust AV and lighting settings, surf the Internet, and browse the music and movie libraries with a natural sweep of the finger using DNav gestures. Crestron DNav technology affords enhanced touch screen functionality, providing dynamic navigation control objects for scrolling effortlessly through all touch screen apps, cover art, and favorite channels.

Embedded PC

The DGE-1's embedded PC engine combines touch screen graphics with built-in Windows Media® Player and RealPlayer®, Internet Explorer, Adobe® Acrobat® Reader, and Microsoft® Word, Excel, and PowerPoint® document viewers. While simultaneously controlling the home, boardroom, or lecture hall, the DGE-1 provides everything needed for enjoying online music and movies, viewing Web pages and accessing most types of digital media without necessitating a separate computer. In addition, VNC Viewer support delivers enhanced cross-platform interaction with computers over the network or Internet, allowing remote access and control of desktop applications to unleash all kinds of new presentation and system integration possibilities.

Full-Motion Video

The DGE-1 supports the display of standard-definition video from an external composite or S-Video source. The video image can be displayed full-screen or in a fully scalable window anywhere on the V-Panel touch screen. External audio signals are handled by a single analog line input.

Streaming Video

Through its embedded Web browser and media players, the DGE-1 supports streaming and downloadable video in a variety of formats, enabling access to all kinds of media from online sources and network servers. Additional support for the motion-JPEG streaming format allows the display of live video from a Web camera or network video streamer (Crestron CEN-NVS100, CEN-NVS200, or equivalent).

IP Intercom

Using the microphone and speakers built into the V-Panel™ display, the DGE-1 supports 2-way voice communication via a choice of IP or Crestron Home (CH) CAT5 wired intercom. Crestron IP intercom eliminates the need for dedicated audio wiring, enabling 2-way speech and room monitoring over Ethernet with other compatible Crestron touch screens. Wired intercom is also supported through a dedicated CAT5 audio connection to a C2N-IADS30X24 or other CH CAT5 switcher or processor.

Keyboard and Mouse Options

On-screen keyboard and mouse capabilities enable complete control of the DGE-1's embedded Web browser and other applications, and can also be used to control external network devices like the Crestron ADMS Intermedia Delivery System™ as well as computers running TouchPoint™ Virtual Mouse and Keyboard Software (VMK-WIN). USB ports are also provided on the DGE-1 and on the V-Panel display, allowing for the connection of a physical keyboard and mouse.

Remote Annotation

Remote annotation capability allows multiple touch screen users to draw with their fingertips over the same video image or whiteboard screen, enabling enhanced interaction between several participants in a courtroom, classroom, or council chamber.

DGE-2: Digital Graphics Engine with HDMI and DigitalMedia CAT Connectivity

A graphics engine for Crestron V-Panel, the DGE-2 supports advanced touch screen performance, with dual video windows and extensive connectivity for high-definition digital and analog sources.

Designed for use with Crestron V-Panel and other touch screen displays, the DGE-2 Digital Graphics Engine allows for a very streamlined touch screen installation by placing the bulk of the electronics at the central equipment location. Mounted within an equipment rack, the DGE-2 connects directly to the head end AV sources, switchers, and control network, while the touch screen display can be up to 450 ft away with just a single cable between them.

The DGE-2 delivers the latest in high-definition touch screen technology powered by our ground breaking Core 3 UI. The features include 24-bit graphics, dual-window HD video and computer display, HDCP support, embedded PC applications and Web browsing, streaming video and audio, IP Intercom, and real-time annotation, all cohesively merged into one seamless user interface through the Crestron Core 3 framework. Connectivity includes: (2) HDMI® inputs, (2) RGB/VGA inputs, (2) multi-format video inputs, balanced stereo audio in/out, Crestron Home® CAT5 Balanced Audio, HDMI and DigitalMedia™ CAT outputs, Cresnet®, and high-speed Ethernet.

Powered by Core 3

The Crestron Core 3 framework enables the generation of dynamically rich user interfaces with greater power and ease than ever. Core 3 lets touch screen designers merge multiple objects and apps on screen leveraging the power of Adobe Flash, multi-format video, Web browsing, IP intercom, and other technologies to deliver an engaging and ultra-intuitive touch screen experience. Use gestures navigation to effortlessly browse through music and movie libraries, scroll through TV channels and radio stations, and select any desired control app from an intuitive menu of colorful 3D icons. Personalize the touch screen desktop with animated clocks, calendars, weather widgets, news feeds, and other informative objects. Even apply themes and backgrounds that change on the fly with each user, event, or season.

But, the power of Core 3 extends beyond impressive graphics and animated objects,unleashing tremendous new capabilities for controlling devices and managing acomplete integrated system. Using the Core 3 SDK, programmers can develop fully functioning "device apps" that can be dropped into each touch screen project without additional programming or resizing. Or, choose from an expanding library of fully developed device apps to instantly add controls for security systems and HVAC, provide sophisticated navigation for media servers and tuners, and enable user friendly editing of lighting scenes and channel presets. With Core 3, the possibilities are virtually limitless.

Embedded PC

The DGE-2's embedded PC engine combines rock solid touch screen graphics performance with built-in Windows Media Player, Internet Explorer, Adobe Acrobat Reader, and Microsoft Word, Excel, and PowerPoint document viewers. While simultaneously controlling the home, boardroom, or lecture hall, the DGE-2 provides everything needed for enjoying online music and movies, viewing Web pages and accessing most types of digital media without necessitating a separate computer. In addition, VNC Viewer support delivers enhanced cross-platform interaction with computers over the network or Internet, allowing remote access and control of desktop applications to unleash all kinds of new presentation and system integration possibilities.

Dual-Window HD Video and RGB

The DGE-2 can simultaneously generate two fully-scalable, full-motion video windows, each supporting standard video, HDTV, and high-resolution RGB signals from external AV and computer sources. Input connections include two HDMI, two analog RGB, and two multi-format analog video. The HDMI inputs support digital HD sources including HDMI, DVI, and DisplayPort Multimode[4]. The RGB inputs handle high-resolution analog VGA computer sources, and the multi-format video inputs accept analog composite, S-Video, and component HD video sources. External audio signals are handled by the HDMI inputs, and by a single analog line input.

HDCP Support

Industry-leading support for HDCP (High-bandwidth Digital Content Protection) ensures seamless compatibility with content-protected DVD, Blu-ray Disc™, digital HDTV, and multimedia computer sources.

Streaming Video

Through its embedded Web browser and media player, the DGE-2 supports streaming and downloadable video in a variety of formats, enabling access to all kinds of media from online sources and network servers. Additional support for the motion-JPEG streaming format allows the display of live video from a Web camera or network video streamer (Crestron CEN-NVS100, CEN-NVS200 or equivalent). IP Intercom

Using the microphone and speakers built into the V-Panel display, the DGE-2 supports 2-way voice communication via a choice of IP or Crestron Home (CH) CAT5 wired intercom. Crestron IP intercom eliminates the need for dedicated audio wiring, enabling 2-way speech and room monitoring over Ethernet with other compatible Crestron touch screens. Wired intercom is also supported through a dedicated CAT5 audio connection to a C2N-IADS30X24 or other CH CAT5 switcher or processor.

Keyboard and Mouse Options

On-screen keyboard and mouse capabilities enable complete control of the DGE-2's embedded Web browser and other applications, and can also be used to control external network devices like the Crestron ADMS Intermedia Delivery System™ as well as computers running TouchPoint Virtual Mouse & Keyboard Software (VMK-WIN). USB ports are also provided on the front and rear of the DGE-2, and on the V-Panel display, allowing for the connection of a physical keyboard and mouse.

Real-Time Annotation

Whether conducting a high-level boardroom meeting, training seminar, or watching sports on a home theater, annotation helps put the fine point on any presentation. Native to the DGE-2, annotation provides the ability to illustrate thoughts on-the fly, draw and write over high-definition video and computer images, and sketch out ideas on a whiteboard screen, without leaving the podium or favorite chair while other viewers watch on the big screen.

Remote Annotation

Remote annotation capability allows multiple touch screen users to draw with their fingertips over the same video image or whiteboard screen, enabling enhanced interaction between several participants in a courtroom, classroom, or council chamber.

Presentation Output

Through its HDMI output, or via a DigitalMedia system, the DGE-2 allows the touch screen image to be sent to additional display devices, allowing videos, PowerPoint presentations, annotation, and other on-screen media to be shared with a live audience.

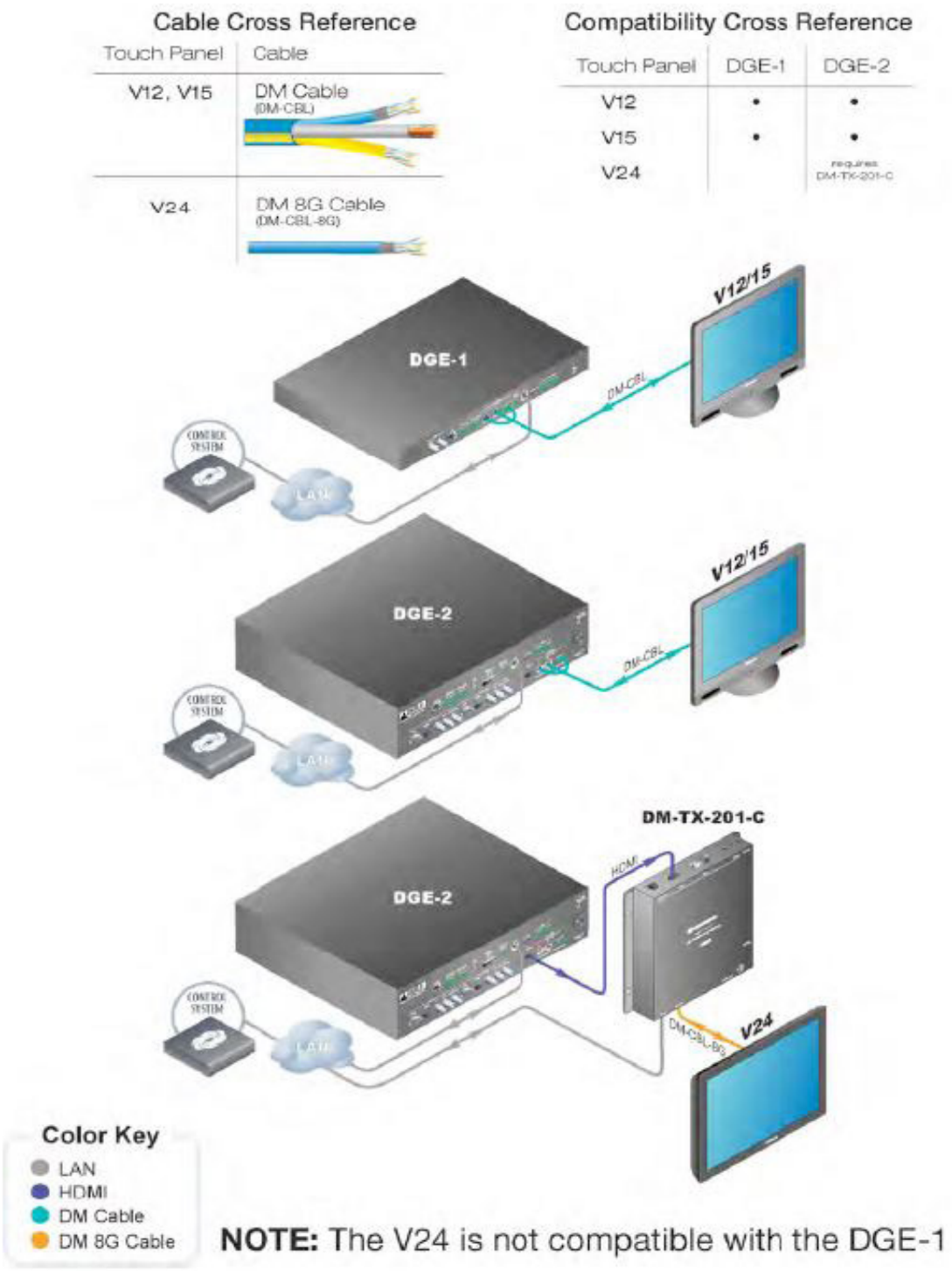
DigitalMedia

DigitalMedia (DM®) connectivity opens up new ways to configure a touch screen system. For instance, using a DM switcher such as the DM-MD8X8, multiple touch screens can be connected to a single DGE-2, providing a simple, cost-effective way for multiple participants to view and control the same graphical interface. DigitalMedia also provides a versatile means for distributing touch screen content to a larger audience, routing the DGE-2's DM output to feed additional video displays and sound equipment. The DGE-2 features a DM CAT type output, supporting the direct connection to VPanel touch screen models V12 and V15, as well as to DM switchers and receivers equipped with a DM CAT input.[2]

V24 Compatibility

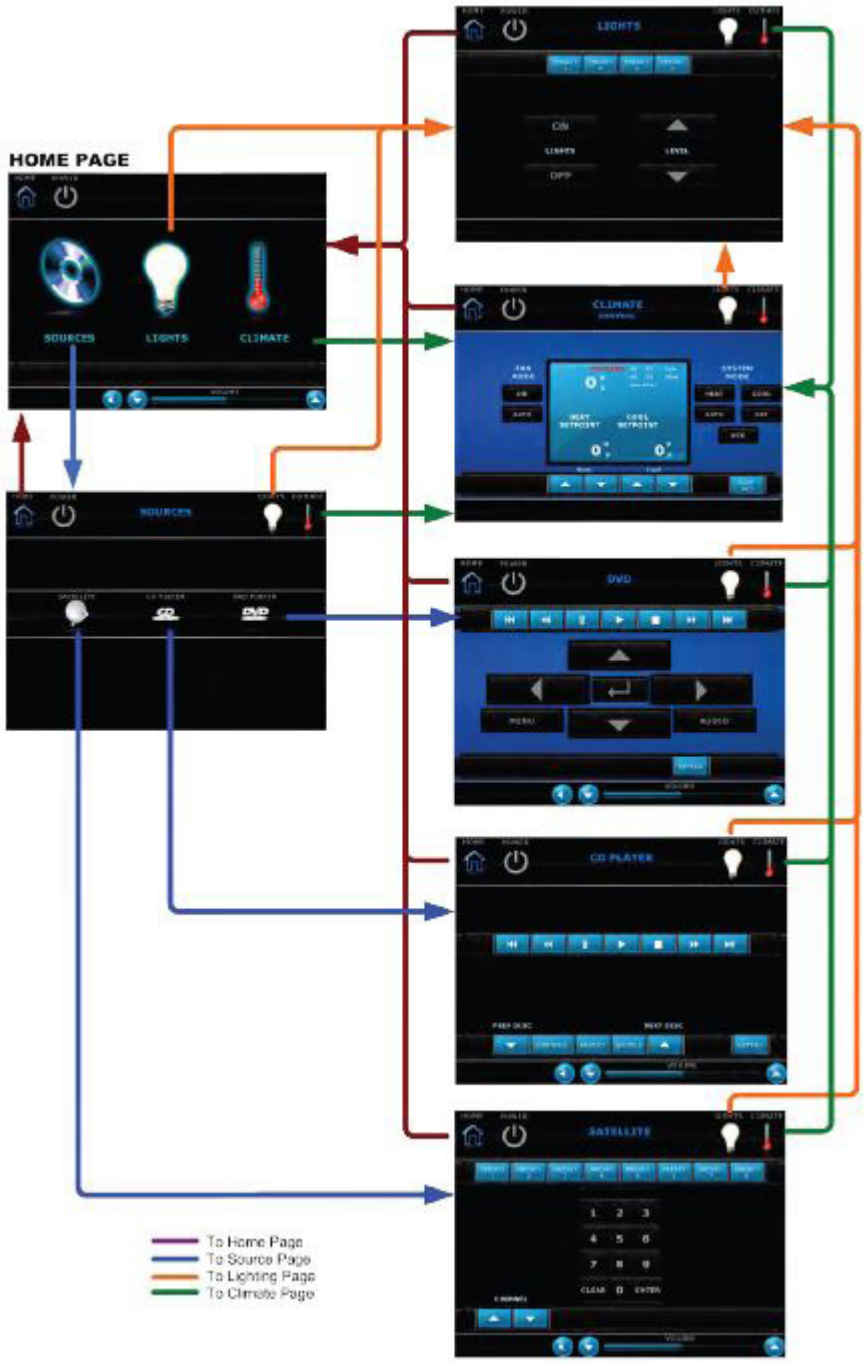
The DGE-2 is also compatible with the new V24 line of V-Panel 24" HD Touch Screen Displays. A DM-TX-201-C DigitalMedia 8G™ STP transmitter provides the interface between the DGE-2's HDMI output and the DM 8G STP input of a V24-C. Alternately, when feeding a V24-C display through a DM switcher, the DM-TX-201-C is not required.

V-Panel and DGE Compatibility



Control System Block Diagrams

This block diagram is an example of a simplified control system, showing the relationship of pages. The arrows represent page flips. Creating a similar diagram for the system is a highly recommended method of organizing projects by allowing the user to visualize the entire system. This makes the task of specifying the controls that appear on each screen much simpler. Refer to Appendix B: Touch Screen Design Example for an example.



Crestron Engraver

The Crestron Engraver allows the user to create projects for engraveable interfaces such as Crestron touch screen hard buttons, keypads, lighting controls, and FlipTop devices. These interfaces provide engrave-able text areas on the buttons, and sometimes, on the faceplates.

Button caps are laser-engrave-able using the Crestron Engraver software; spacers are not engrave-able. The engraving software provides up to three fields for each button cap to allow for the left/right and center press functions, permits multiple lines of text, and also allows the user to specify the orientation of each button cap.

Use the Engraver to assign text, combine and un-combine buttons, exclude buttons, and add decorative borders. Send the completed engraving project to Crestron via email for quick processing using the latest high quality laser engraving technology. The new Crestron engraving software and equipment offers a more streamlined process that allows for the delivery of finished buttons within 2-3 business days.

The Crestron Engraver allows the user to create cutout projects for non-engrave-able devices such as Crestron switchers and control modules. These devices provide plastic slots where labeled strips can be inserted to identify the push buttons on the unit. Use the Engraver to create and print the labeled strips that are properly formatted and sized for the device. Simply cut the strip from the printout using the cut marks as a guide, and insert the strip into the plastic slot.

For engrave-able devices such as Crestron keypads and touch screens, use the Crestron Engraver to:

- Select the color and finish of the faceplate and trim.
- Combine and un-combine button caps and engrave-able text areas.
- Exclude button caps.
- Assign text and decorative borders to buttons and engrave-able text areas.

Once the engraving project is created, send it directly to Crestron via email for quick processing using the latest laser engraving technology. For non-engraveable devices, use the Engraver to design and print cutout labels that are correctly formatted and sized for insertion into the plastic slots on the unit.

Printer and Paper Requirements for Cutout Labels

Adagio projects: Ink jet printer with ink jet transparency film.

Non-Adagio projects: 100 lbs (maximum) paper weight; flat (not glossy) paper type.

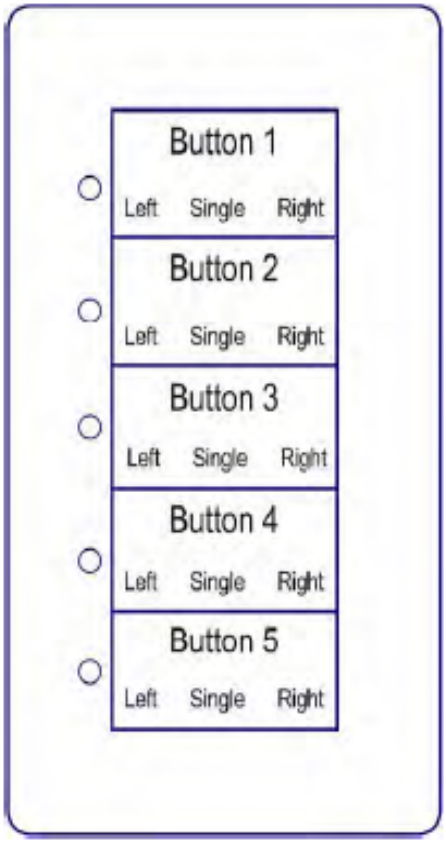
C2N-CBD and C2N-CFB Series Engraving

The engraving software provides a single line of up to 10 characters, including spaces, for single-button caps, two lines of characters on double and triple-button caps, and a single line of up to four characters for small split-button caps. Crestron Engraver software, Version 5.04.003.00 or later, is available from the Crestron Web site.

Button Panel Specifications

C2N-CB Series Cameo Keypads Description

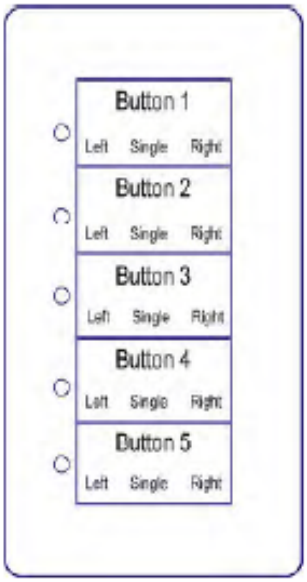
The C2N-CB may have one to six switches, each programmable for left/center/right “rocker” action, single press operation, or press/hold mode, enabling up to 18 functions. Each Cameo® keypad is supplied with six single-row switch caps, three double-row switch caps, and two triple-row switch caps as well as two single-row button blanks, one double-row button blank, and one triple row button blank—any combination may be used. To the left of each button an independently addressable white feedback LED indicates active switch status. The intensity of these feedback LEDs is programmable from 0 to 100%.



The switch caps have white LED backlighting that is programmable from 0 to 100% intensity as well. True backlighting is not practical in certain circumstances, such as when using black switch caps. Instead, the program can use the feedback LEDs to perform a backlighting function, turning them all on but at a fixed percentage of their active state intensity.

Form D - Cameo Keypad Specifications

Project Name	Date
Order/Quote #	Page of
Location	



Button Engraving
1
2
3
4
5
6
Notes

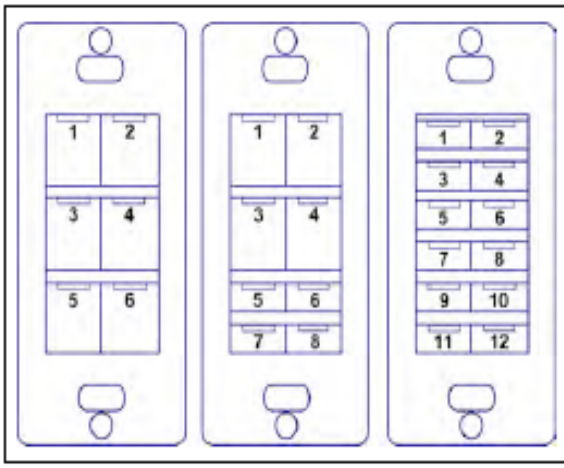
Button Number	Function	Left	Right	Single Button	*Keypad Backlight %	*Keypad Feedback %

*Keypad backlight and keypad feedback levels are global for the entire keypad. These levels cannot be adjusted on an individual button basis.

Form E - C2N-DB6/8/12 Decorator Keypad Specifications

Project Name	Date
Order/Quote #	Page of
Location	

The C2N-DB6/8/12-series Decorator Wall Panels are wall-mounted, single-gang user interfaces. Panels are available in 6-, 8-, or 12-button configurations and accommodate standard faceplates. The intensity level for the keypad LED can be set from 0 to 100%.



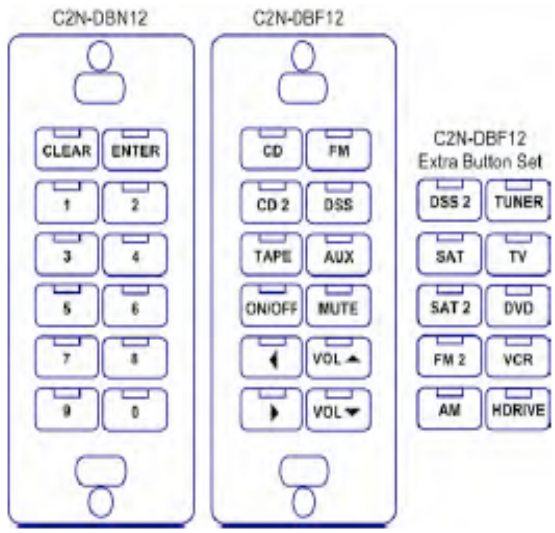
Button Engraving	
1	2
3	4
5	6
7	8
9	10
11	12

Button Number	Function	*Keypad Feedback %

*Keypad backlight and keypad feedback levels are global for the entire keypad. These levels cannot be adjusted on an individual button basis.

Form F - C2N-DBN12 & C2N-DBF12 Decorator Keypad Specifications

Project Name	Date
Order/Quote #	Page of
Location	



Each keypad has 12 buttons with LED windows.

The C2N-DBN12 has a CLEAR button, an ENTER button, and numeric digit buttons 0 through 9.

The C2N-DBF12 has six source selector buttons, an ON/OFF button, a MUTE button, device transport control and volume control buttons.

A kit with additional source buttons for the C2N-DBF12 is also provided.

Source Button	Function	*Keypad Feedback %

*Keypad backlight and keypad feedback levels are global for the entire keypad. These levels cannot be adjusted on an individual button basis.

Form G - CNX-B2/B4/B6/B8/B12 Single Gang Keypads Specifications

Project Name	Date
Order/Quote #	Page of
Location	

The feedback LED illumination is independently addressable, and is programmable. These keypads also contain a temperature sensor that reports to the Cresnet control system, and an audio speaker that can provide audio feedback via WAV sound files. Backlight and button LED intensity levels can be set from 0 to 100%. Similarly, the speaker volume level can be set from 0 to 100%. The number of buttons on a keypad can be 2, 4, 6, 8, or 12. They are arranged numerically from left to right, top to bottom and each has an associated LED window.
Numbers in the illustration are for programming only.

CNX-B2 CNX-B4 CNX-B6 CNX-B8 CNX-B12

☐ ☐ ☐ ☐ ☐

Use checkbox to note model.

Button Engraving	
1	2
3	4
5	6
7	8
9	10
11	12

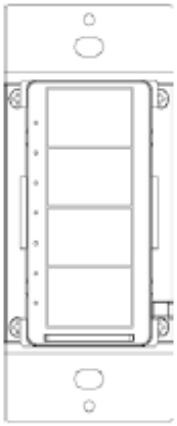
Button Number	Function	Engraving	WAV File	*Keypad Backlight %	*Keypad Feedback %

*Keypad backlight and keypad feedback levels are global for the entire keypad. These levels cannot be adjusted on an individual button basis.

Cameo and Cameo Express In-Wall Dimmers and Switches

Cameo buttons can be swapped in the field, making it easy to change engraving or color after installation. Buttons control in-room audio or lamps in addition to any other light connected to the system. Cameo also functions as a keypad, sending commands to trigger whole-room lighting scenes or distributed audio functions. Supporting one, two, three, or four buttons, the in-wall dimmer serves as a great user control interface in any Crestron system. Engravable button caps are included.

Model	Description
CLW-DIMCN-P	Wired In-Wall Dimmer
CLW-DIMEX-P	Wireless In-Wall Dimmer
CLW-SWCN-P	Wired In-Wall Switch
CLW-SWEX-P	Wireless In-Wall Switch
CLW-DIMSWCN-P	Wired In-Wall Dimmer/Switch Combo
CLW-DIMSWEX-P	Wireless In-Wall Dimmer/Switch Combo
CLW-FANSWCN-P	Wired In-Wall Combination Ceiling Fan Controller/Switch
CLW-FANSWEX-P	Wireless In-Wall Combination Ceiling Fan Controller/Switch
CLW-SLV-P	In-Wall Remote Dimmer/Switch
CLW-DIMEX-E	Express Wireless In-Wall Dimmer
CLW-SWEX-E	Express Wireless In-Wall Switch
CLW-DIMSWEX-E	Express Wireless In-Wall Dimmer/Switch Combo
CLW-FANSWEX-E	Express Wireless In-Wall Combination Ceiling Fan Controller/Switch



Form H - Cameo and Cameo Express

Button	Function	Engraving	Feedback/Bargraph

CC2N-CBF-P Cameo Keypad, Flush Mount

C2N-CBD-P Cameo Keypad, Standard Mount

Exquisitely simple yet highly customizable, a single Cameo Keypad can be configured easily by the installer to provide from two to eight buttons. Each keypad is actually furnished with an assortment of engrave-able button caps in four different sizes to support a variety of physical layouts. Through programming, each button can be configured to use "button events," affording up to three separate functions per button by tapping, double-tapping, or holding the button. "Shift key" functionality is even possible, allowing any button to be held while pressing another. Split small buttons may be installed in the bottom two positions only. Includes two (2) large, three (3) medium, six small, and four (2 pair) split small button. When a button cap covers two or three buttons, the bottom button of the set is activated. For example: For a two-button cap, if buttons 1 and 2 are covered, when the button is pressed, this will activate button 2. For a three-button cap, if buttons 4, 5 and 6 are covered, when the button is pressed, this will activate button 6. For a single button cap, if button 7 is covered, when the button is pressed, this will activate button 5.

NOTE: No LED feedback will be provided for buttons 7 and 8.

Form I - C2N-CBF-P & C2N-CBD-P

Button Number	Function	Engraving	Tapping	Double Tap	Hold	"Shift"	Feedback/ Bargraph

HTT-B10X and HTT-B10EX Tabletop Keypads

The HTT-B10X and EX provide an elegant keypad for lighting, climate, and audio control. Ten backlit engravable buttons with white LED feedback, auto-dimmable backlight and LED intensity, and true-feedback and dual-bargraph capability. The HTT-B10X is shipped with 10 blank buttons (two columns of five buttons each). Ten simple push buttons provide just the right amount of control without clutter or complication - perfect for most applications. For situations requiring a little more, each button can be configured to enable up to three separate functions simply by tapping, double-tapping, or holding the button. "Shift key" functionality is even possible, allowing any button to be held while pressing another. Ten different blink patterns are built in, enabling all kinds of blinking LED feedback while simplifying programming and minimizing traffic on the infiNET network. Additional bargraph capability uses the same LED's to display actual level settings in the form of two vertical 5-segment bargraphs.

Model Number	Description
B10-BTNB-T 5 Blank	Blank Buttons, Black
B10-BTNB-T 5 Engraved	Engraved Buttons, Black
B10-BTNW-T 5 Blank	Blank Buttons, White
B10-BTNW-T 5 Engraved	Engraved Buttons, White

Form J - HTT-B10X

Button Number	Function	Engraving	Tap	Double-Tap	Hold	Feedback
1						
2						
3						
4						
5						
6						
7						
8						
9						
10						

Lighting Control Interface

Crestron lighting and automation solutions provide unmatched value and performance, comprising a comprehensive line of modular enclosures, wall box dimmers, and climate control thermostats, all under the command of the powerful 2-Series control system.

Converting Crestron Components to a User-friendly Lighting Interface

Crestron offers the most complete selection of user interfaces available. Elegant keypads and touch screens provide convenient fingertip control access throughout any environment. Every installation is fully customizable to attain streamlined control and automation of complex system functions, and end-user comfort. Nearly limitless connectivity options are also available to support integration with non-Crestron components.

Crestron control can change the ambience of a room at the press of a button, schedule landscape lighting to turn on automatically at dusk, or remotely adjust the air conditioning from a mobile phone or PDA. Lighting, climate control, security, access control, irrigation, window treatments, pool and spa, A/V, and other systems all integrate seamlessly. In order to properly design a lighting control system for the project some specific information is required.

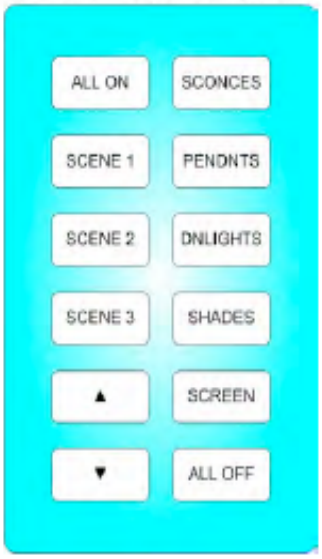
- Project name
- Project Location
- Contact information for the project system designer
- A load schedule or panel schedule indicating controlled lighting loads types (incandescent, magnetic or electronic low voltage, fluorescent, etc.) and the number of types assigned to each circuit.
- The voltage for each load.
- The ballast types specified for fluorescent dimming (2, 3 or 4 wire) or ELV if applicable.
- The Emergency power requirements – indicating which loads are connected to emergency power
- The Spare circuits required
- The External systems interface(s)
- Any other special considerations, (i.e., specific panel locations, main or branch circuit breaker requirements, etc.) The touch screen Graphical User Interface (GUI) and the keypads are the only components that the end-user sees or touches. It is the user's primary point of interaction with the complete system. So it stands to reason that the quality of the GUI design and button layout largely determines the ultimate usefulness of the entire system.
- Use as many copies as necessary of the following forms to specify the user interface.

Form K - Lighting Control Programming Request - Keypads

Job Name: Date:

Load Name: Job #:

Location: Start Up Date:



Button Number	Function	*Keypad Backlight %	*Keypad Feedback %

*Keypad backlight and keypad feedback levels are global for the entire keypad. These levels cannot be adjusted on an individual button basis.

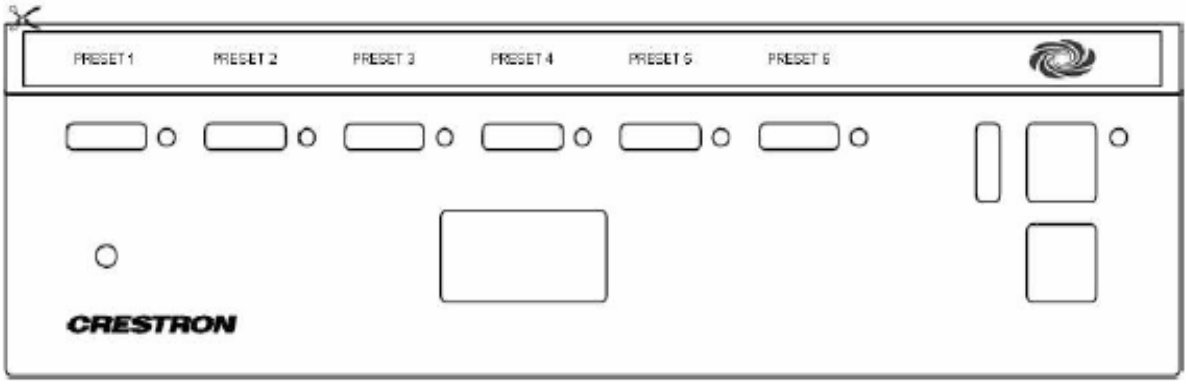
Form L - Lighting Control Programming Request - iLux

Job Name: Date:

Load Name: Job #:

Location: Start Up Date:

Contact Name: Contact Phone:



Button Label	Function

Form M - Lighting Control Programming Request - TPS-4L Touch Screen

Job Name: _____ Date: _____

Load Name: _____ Job #: _____

Location: _____ Start Up Date: _____

Contact Name: _____ Contact Phone: _____

Load Number	Description

Form N - Lighting Control Programming Request - TPS-6L Touch Screen

Job Name: Date:

Load Name: Job #:

Location: Start Up Date:

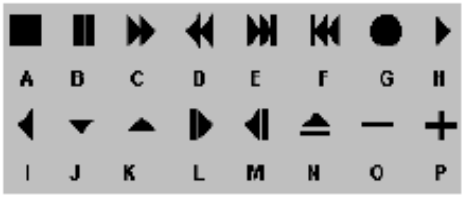
Contact Name: Contact Phone:

Load Number	Description

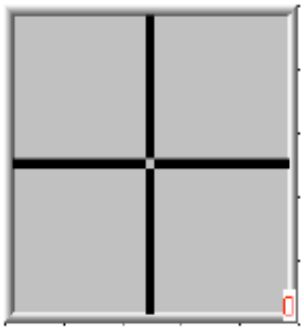
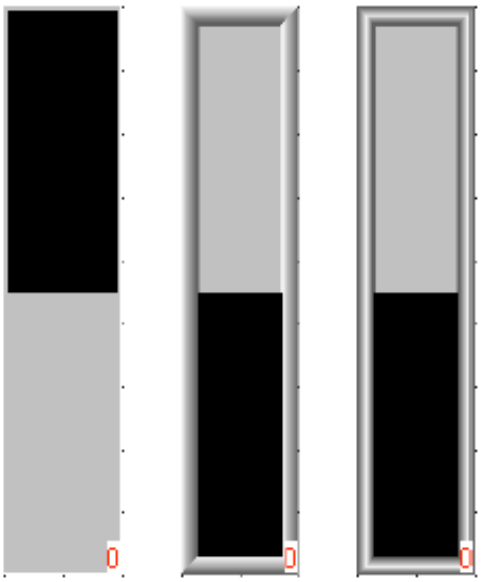
Appendix A: Touch Screen Objects

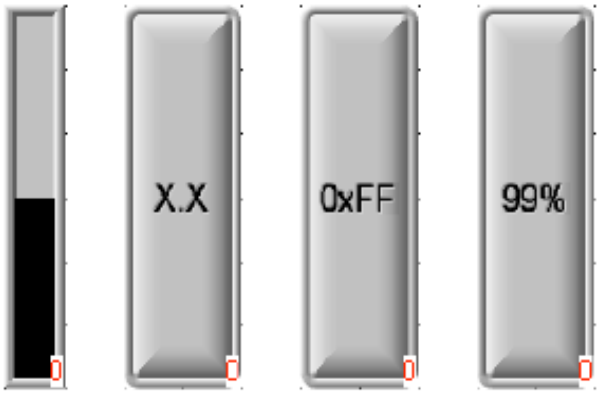
The following charts illustrate the objects that can exist on a touch screen. When designing a touch screen layout, it is important to keep it a relatively simple, clean design and easy to use. Take into account the limited screen area of each page and avoid overcrowding.

NOTE: Not all touch screens support the entire list of objects described in this kit. Refer to the product specific manual for details accessed from the Crestron Web site.

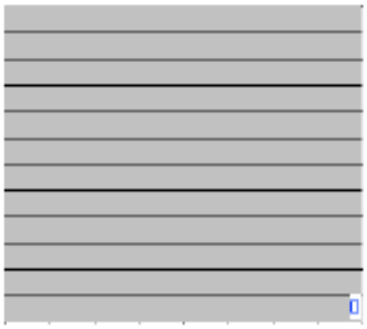
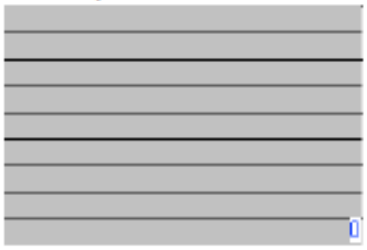
Buttons	Example Styles
A button triggers most of the actions in a control system. Buttons are available in many styles and can be any size. However, you must take the human interface into account and allow the button to be large enough for descriptive text and for ease of fingertip selection. For smaller touch screens, the minimum recommended size is 40 pixels wide by 40 pixels high. For larger touch screens, the minimum recommended size is 60 pixels wide by 50 pixels high. Button colors are limited by the size and type of touch screen. For example, the TPS series supports up to 65,536 colors; the LC-1000 supports up to 256 colors. You can choose a basic color or define the Red Green and Blue values. The number in the lower right corner of each button represents a "join" to a particular function as defined in the programming. Each join number is unique and serves a specific purpose. A key-click sound can be assigned to a button. For touch screens that support audio, a button press can also initiate a WAV file, and provide an audio feedback for a particular function.	Most Crestron touch screens support a variety of button styles, including shaded, three-dimensional, and two-dimensional. Shown here with optional frames. In addition, buttons can be round, elliptical, Ob-round, or have a particular corner radius applied. The buttons provide positive visual feedback when pressed. The amount of text that can fit on a button is governed by the button size and the font size and type. The Crestron Transport Font, available in VT Pro-e, consists of symbols that represent standard device functions such as Fast Forward, Rewind, Volume Up, Volume Down, etc. 

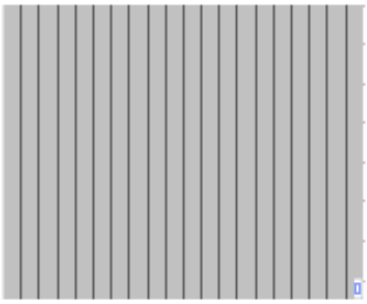
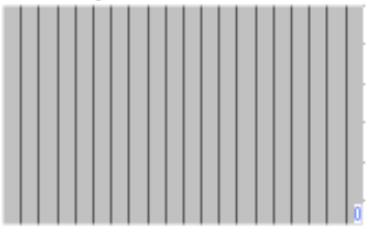
Shown here are additional button shape choices: Obround, Elliptical, and Radius 2 through 5.

Sliders	Example Styles
A slider controls and displays an analog value, such as lighting, temperature, audio volume, balance, bass or treble. Sliders can be two-dimensional, raised, or neon framed. The thickness of the slider frame (or None for no frame) may be selected. The color of the face, frame, text and indicator bar may all be chosen independently. Choices for the type of indicator are Bar, Line, or None. When choosing a line slider, you may optionally control two separate analog functions with one slider. 	Bar sliders shown here in two-dimensions, raised, and neon.  Sliders may be drawn vertically or horizontally.

Gauges	Example Styles
A gauge displays analog levels such as lighting, temperature, or audio volume. Digital Gauge A digital gauge displays values such as lighting levels, temperature, or audio volume, in digital format (with or without a decimal point). Hex Gauge A hex gauge displays values such as lighting levels, temperature, or audio volume, in hexadecimal format. Percent Gauge A percent gauge displays values, such as lighting levels, temperature, or audio volume, as a percent.	Gauges may be horizontal or vertical. Pictured from left to right; graphic gauge, digital gauge, hex gauge, and percent gauge. 

Clock	Example Styles
A clock object displays the time of day in either a 12-hour or 24-hour format. Seconds and a blinking colon may also be chosen. Clock objects can be embossed, raised, shadowed aliased, or anti-aliased.	The thickness of the frame (if you use one), the color for the clock face, frame and text, and the font can all be selected.

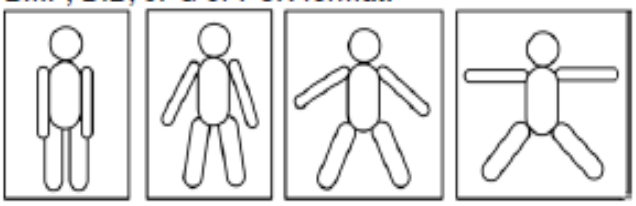
Video Objects	Example Styles
A video object (often referred to as a video window) displays real-time video on the screen. Recommended minimum video window size (4:3 aspect ratio) is 93 pixels by 69 pixels. Maximum video window can be full screen. A full screen transparent button can be placed on top of the video object to return to the previous page. Video objects can be any size or set to the 4:3 or 16:9 aspect ratio.	4:3 Aspect Ratio  16:9 Aspect Ratio 

RGB Video Objects	Example Styles
An RGB video object (often referred to as an RGB video window) displays real-time RGB video on the screen. Recommended minimum RGB video window size (4:3 aspect ratio) is 93 pixels by 69 pixels. Maximum video window can be full screen. A full screen transparent button can be placed on top of the RGB video object to return to the previous page. RGB Video objects can be any size or set to the 4:3 or 16:9 aspect ratio. **NOTE:** All RGB and Video objects are scaled.	4:3 Aspect Ratio  16:9 Aspect Ratio 

Text Box	Example Styles
A text box enables you to add headings, titles, instructions, or other text to a page.	 Font size, color, type and position are all selectable.

Image	Example Styles
An image object enables you to add a decorative image to a page.	 The image object can be any size and contain BMP, PCX, DIB, or a JPEG image.

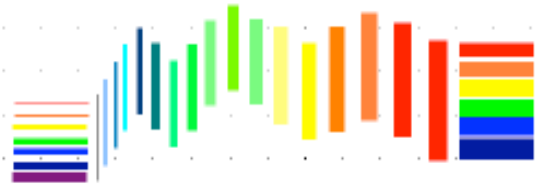
Legends	Example Styles
A legend is similar to a button in that it has two states. However, it cannot trigger a control system action; rather, it is typically used to control the display of text via its digital feedback signal.	Color, frame thickness, style, text, font and font color are all selectable. Legends may also be displayed as a round, elliptical, Ob-round, or radius selected object.

Animation	Example Styles
An animation object creates the illusion of movement on the page, by using a succession of static images that are displayed at a set speed. You can specify the translucency of an animation object from 0% (opaque) to 100% (completely transparent). If the resolution of any image is higher than 16 bits (65536 colors), VisionTools Pro-e will automatically convert it to 16 bits when uploading. The resolution of every frame in the animation sequence will be converted to the highest resolution of any frame in the sequence.	Example of four animation frames, they can be BMP, DIB, JPG or PCX format.  Images can be played forward or forward and backward. The associated logic permits the animation to run with many options. For example, only when a certain button is pressed.

NOTE: There is no specific rule about how many animations or how large an animation can be for a page. However, too many animations or large animations can degrade performance. A good rule to keep in mind is to limit the animation size to one quarter of the total screen size.

Timers	Example Styles
A timer measures and displays time in two formats, hours, minutes and seconds, or hours and minutes. Maximum range is zero to 18H:12M:15S. Timers can be used for example to display values that are specific to the touch screen, such as timeouts.	Examples of timers, left to right, without border, thin border, medium border, and thick border.

Borders	Example Styles
A border is a decorative element that serves to group together related objects and to help visually clarify and organize the page. A border may contain text.	Borders may be any color, 2-dimensional, 3-dimensional, shaded, and may be framed. Shown here, 2D, unframed and shaded framed.

Lines	Example Styles
A line object enables you to add a line of any angle to the page.	Lines can be any color, and from 1 to 16 pixels wide. 

Web Objects

Web Map

A Web map is a graphic image in an HTML page that contains links to other targets. The clickable ares in the image are referred to as the "hit points." When the hit points are selected, the Web browser displays the target, which can be another page, a URL or a different area within the same (large) page.

Web Anchor

A Web anchor allows the Web browser to jump to a different section of the current HTML page - either when a button or hit point is clicked - while giving the appearance to the user that an entirely different page is being displayed. In this way a single HTML page can be designed that downloads once, rather than a number of pages that each take time to download.

Web Marquee

A Web marquee displays scrolling text within a framed box.

Web Dial

A Web dial enables the mouse pointer to control and adjust analog values such as lighting levels, audio volume and temperature.

XPanel Projects

Within VT Pro-e, Crestron touch screen GUI design software, there are four XPanel options. All are compatible with any Ethernet-equipped 2 or 3-Series control system, which support DHCP/DNS for the ultimate integration of IT and AV.

- **XPanel EXE** - provides ultra fast and secure control through an executable application rather than web pages. The runtime executable loads directly onto one or more specific computers and runs from the desktop or start menu.
- **XPanel IE** - provides web browser based control using ActiveX to attain true Crestron touch screen behavior.
- **XPanel PDA** - brings the power of e-Control to any Pocket PC 2002 device. XPanel PDA delivers benefits similar to XPanel EXE on smaller PDA and Table PC formats.
- **XPanel Emulator** - allows the control system programmer to easily generate an executable file that emulates the entire flow and function of an Isys touch screen or e-Control 2 XPanel project on any Windows® PC.

Adobe Flash SDK

Adobe Flash SDK harnesses the power of the Adobe development environment ot enable cross platform control from any computer. Compatible with any Web browser supporting Flash 9 and ActionScript 3.0, the Flash SDK allows developers to author dynamic user interfaces and interactive content for all types of applications. Add control functionality to any Flash CS3 element with full two-way communication of Crestron data.

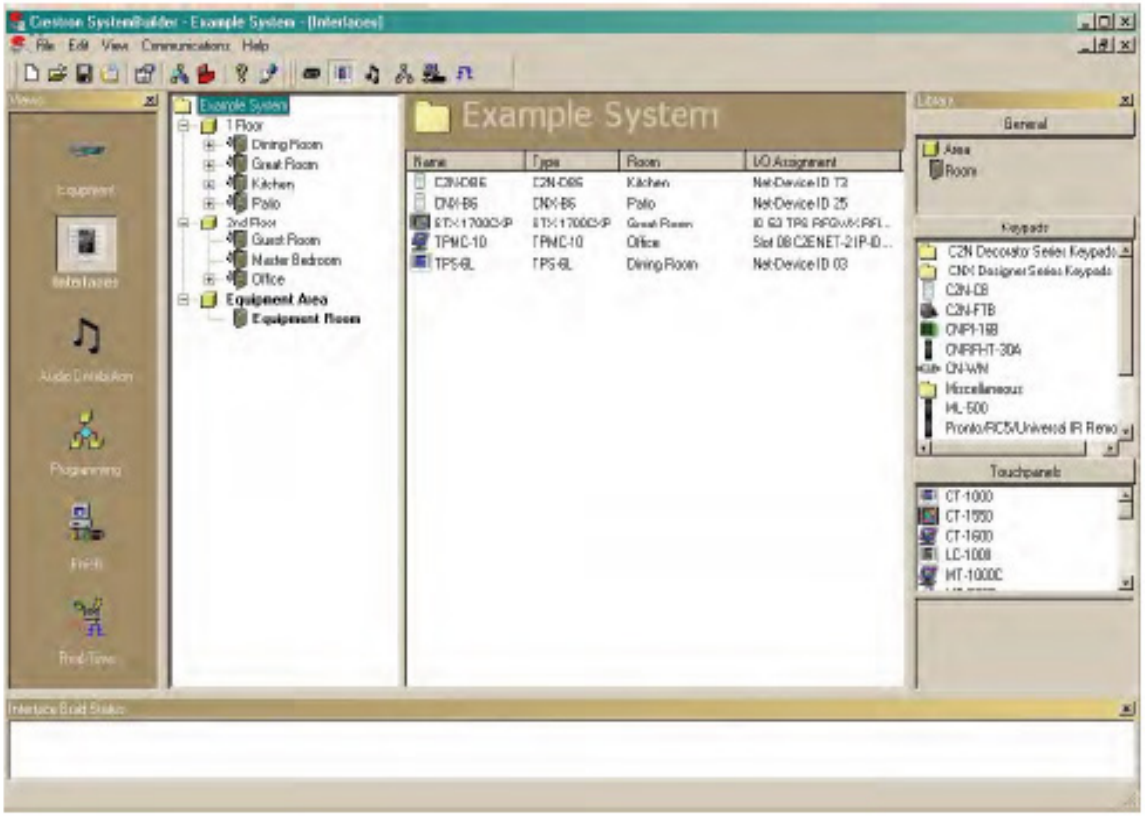
Appendix B: Touch Screen Design Example

The following example of touch screen design is based on the following parameters, and uses a PRO2 Professional Dual Bus Control System.

Interface	Location
C2N-DB6 Keypad	Ktichen
CNX-B6 Keypad	Patio
STX-1700CXP Touch Screen	Great Room
TPMC-10 Touch Screen	Office
TPMC-6L Touch Screen	Dining Room

Controlled Equipment	Location
CD Jukebox	Equipment Room
DSS Receiver	Equipment Room
STX-1700CXP Touch Screen	Equipment Room
TPMC-10 Touch Screen	Equipment Room
TPMC-6L Touch Screen	Equipment Room

SystemBuilder Interface View of Example System



SystemBuilder can generate a complete Bill of Materials.

CRESTRON

Qty	Name	Description
1	PRO2	Professional Dual Bus Control System

Qty	Name	Description
1	CNX-PAD8A	8 Source/8 Room Enhanced Professional Stereo Audio Distribution Processor
1	CNAMPX-16X60	16 Channel Intelligent Amplifier
1	TPS-RFGWX	2-Way RF Transceiver/Wireless Gateway for Isys Tilt Models
1	C2N-TTVFM	TV and FM Tuner, the C2N-TTVFM is a cable-ready television tuner and FM radio tuner.
1	C2N-TAMWX	AM/Weather Radio Tuner

Qty	Name	Description
1	C2N-DB6W	6 button decorated style keypad, backlit, white
1	CNX-B6W	6 button keypad, backlit, white
1	TPS-FPW	White Faceplate

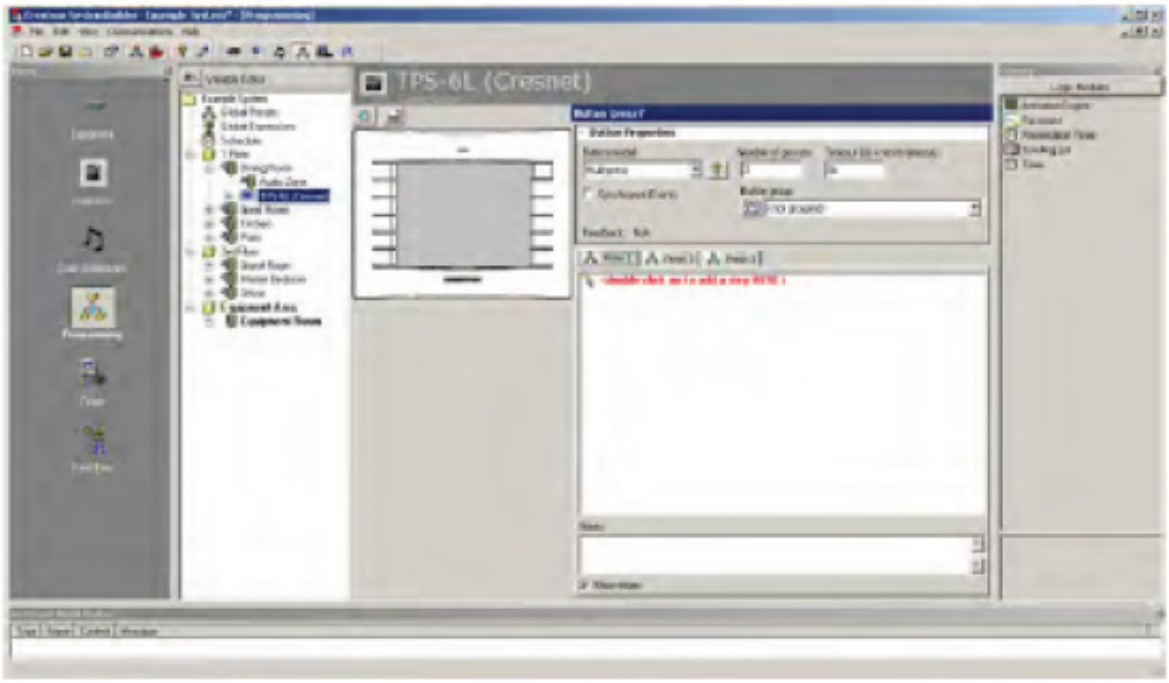
Qty	Name	Description
1	TPS-6L	Isys 5" Lectern/Wall Mounted Touch screen
1	ST-1700C	1-Way 6" Wireless Color Touch screen
1	1700C-BTNB	Black buttons only (no faceplate)
1	TPMC-10	Isys i/O WiFi Tablet Touch screen

Qty	Name	Description
1	CLX-1DIM4	1-20A Feed, 4 Controlled Circuits Dimmer

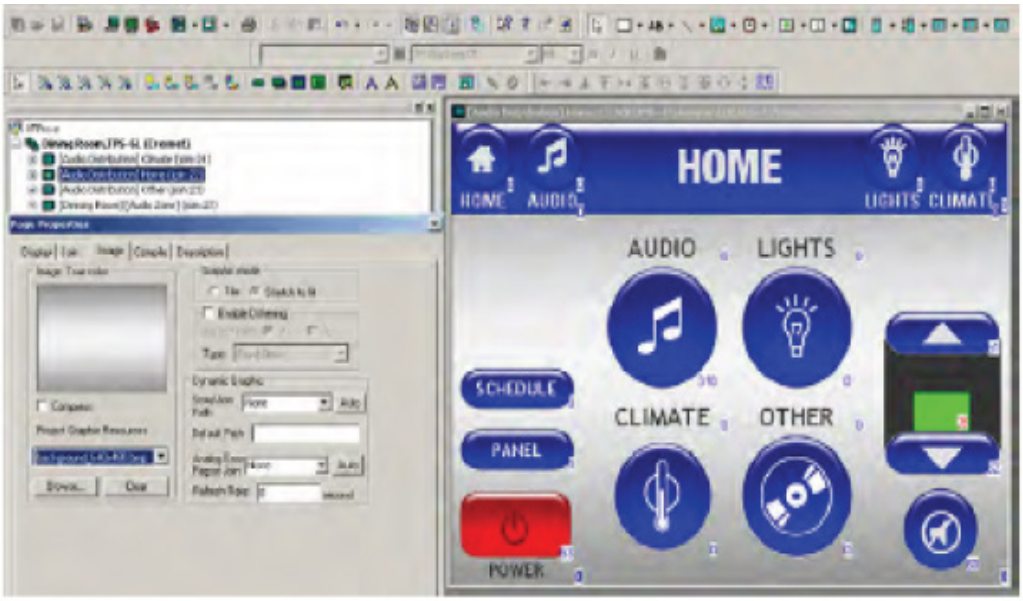
Qty	Name	Description
1	CLT-1DIM4	Terminal block for CLX-1DIM4

Qty	Name	Description
1	C2ENET-2	Dual Port Ethernet Card for 2-Series Control Systems

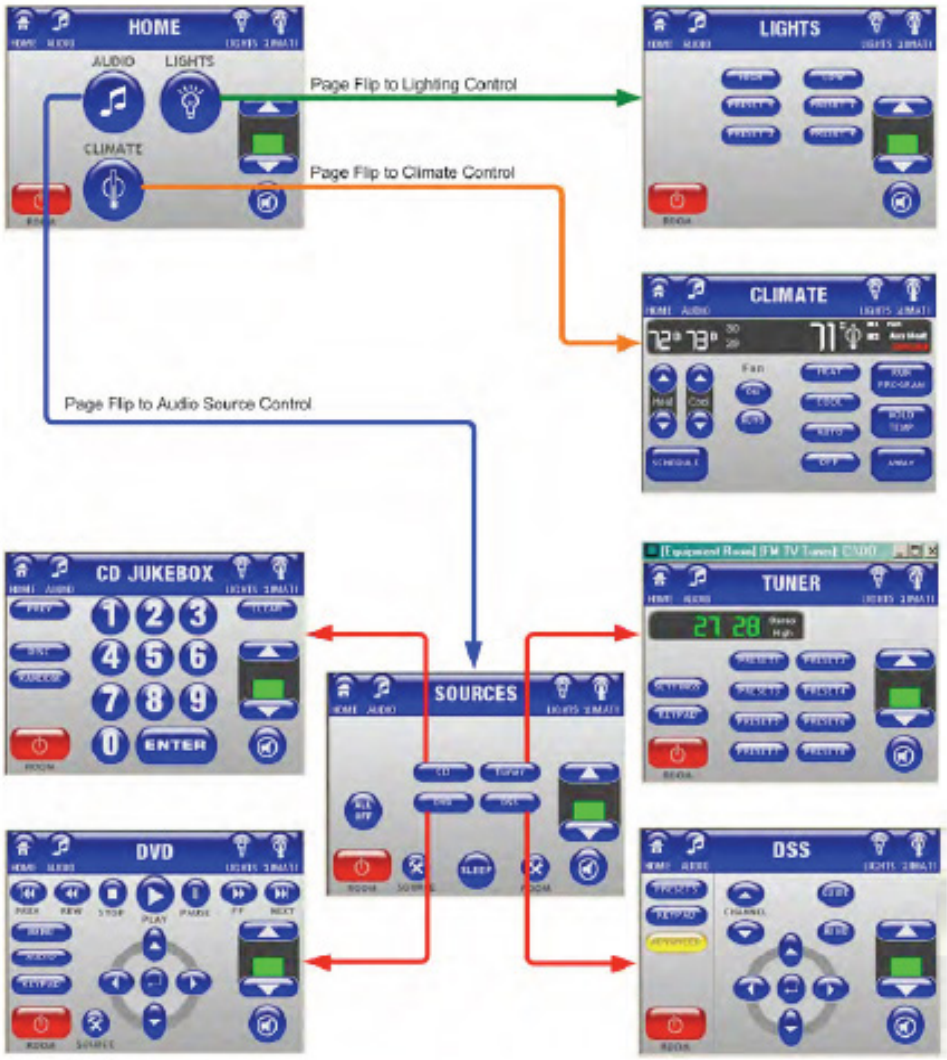
In SystemBuilder, click the Programming button and select the TPS-6L.



The buttons are easily programmed in SystemBuilder. The following touch screen programming example was created using the gel blue.vtt template in VT Pro-e. When a template is applied, the user can select from a list of Project Graphic Resources to maintain professional consistently and usability throughout the design process.



The Home page in the following example is linked to the transport pages for the DSS, CD Jukebox and DVD. The climate control and tuner control are also included. Refer to the following chart.



Examples of Image Resource Files Used for This TPS-6L Example in VT Pro-e

Background Resource Example

Button Resource Example

Indicator Resource Example

Appendix C: Color Theory

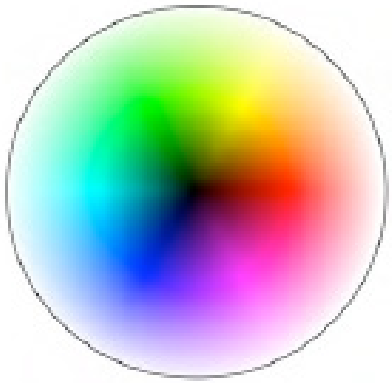
The following color definitions may be useful when considering interface design.

- 8-bit color allocates 8 bits (1 byte) of memory to each pixel, up to 256 different colors.
- 16-bit color allocates 16 bits (2 bytes) of memory to each pixel, producing 65,536 colors.
- 24-bit color uses 24 bits (3 bytes) of memory per pixel in a color image, up to 16,777,216 colors can be represented in the color palette.
- True color is 32-bit color. The extra byte, called the alpha channel, is used for control and special effects information (for example, transparency).

Colors can appear in nearly infinite variation, which can make selecting appropriate colors for the project difficult. This guide attempts to simplify the choices by presenting a few basic principles of color theory.

There are three basic (primary) video colors, red, green, and blue. All other colors are derived from these three.

Mixing two of the primary colors creates the secondary colors. Red plus green = yellow, Blue plus red = magenta, and blue plus green = cyan.



Light versus Paint

Touch screens use Red, Green, and Blue as their primary colors. The screen emits light made up of thousands of tiny red, green, and blue pixels that are so close together it is not easily to distinguish an individual light emitter. By turning these lights on and off, the illusion of mixed colors is reproduced. In the case of a touch screens, black is the absence of all light (all light emitters off) and white is the presence of all light (all red, green and blue light emitters on full).

The painter's palette operates on a different principle. The white surface of a paper or canvas reflects all available light and appears white. Adding colors to the white background decreases the amount of light by absorbing specific frequencies of light. For example, red absorbs the green and blue light. What we see is the light reflected from the surface to our eyes. For paints, the absence of all paint is the white surface, and the presence of all colors is black, absorbing all light.

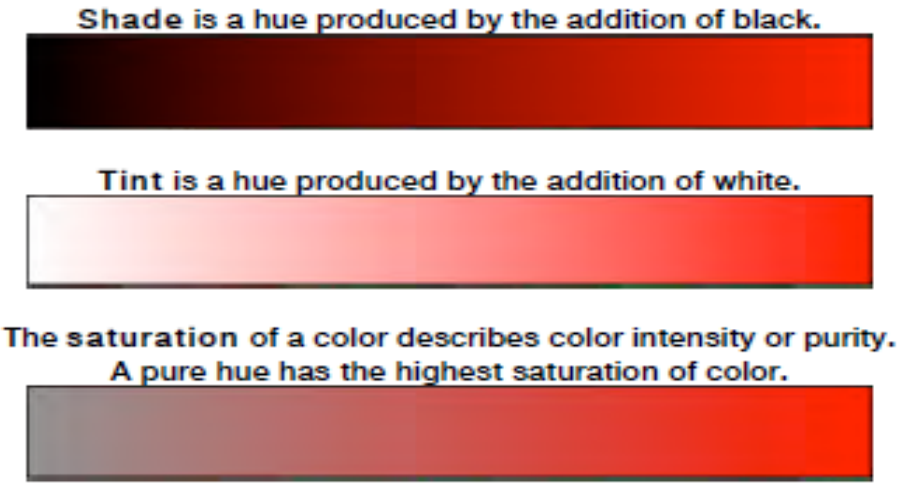
It is important to keep in mind that when designing a touch screen the surface is painted with light.

Color Properties

A color is described using three properties: color name, degree of saturation, and its value or lightness. For example, pink, fire engine red, and brick are all in the red color family, they differ because of their saturation and intensity.

Hue, intensity, saturation and luminance/value are inter-related terms and have to do with the description of a color. Hue is the term for the pure spectrum colors that are usually referred to by name - red, orange, yellow, blue, green and violet.

Value (or luminance) is the lightness or darkness of a color. The value is a function of shade and tint.


Shade is a hue produced by the addition of black.
Tint is a hue produced by the addition of white.
The saturation of a color describes color intensity or purity.
A pure hue has the highest saturation of color.

Color Perception

Warm colors (reds, and yellows) appear to be in front of cool colors (blues and violets). The warm colors seem to advance or be on top of or in front of the receding cool colors. In addition, there are other psychological components to color. Red is the color of fire and blood, so it is associated with energy, war, danger, strength, power, determination as well as passion, desire, and love.

Red is a very emotionally intense color. Red brings text and images to the foreground. Use it as an accent color to stimulate people to make quick decisions. Red is widely used to indicate danger.

Orange combines the energy of red and the happiness of yellow. It is associated with joy, sunshine, and the tropics. Orange represents enthusiasm, fascination, happiness, creativity, determination, attraction, success, encouragement, and stimulation. To the human eye, orange is a very hot color, so it gives the sensation of heat. Orange is not as aggressive as red. Orange has very high visibility, use it to catch attention and highlight the most important elements of the design.

Yellow is the color of sunshine. It is associated with joy, happiness, intellect, and energy. Yellow produces a warming effect, arouses cheerfulness, stimulates mental activity, and generates muscle energy. Yellow is often associated with food. Bright, pure yellow is an attention getter, which is the reason taxicabs are painted this color. Yellow is seen before other colors when placed against black; this combination is often used to issue a warning. Yellow is very effective for attracting attention, so use it to highlight the most important elements of the design. Light yellow tends to disappear into white, so it usually needs a dark color to highlight it. Shades of yellow are visually unappealing because they loose cheerfulness and become dingy.

Green is the color of nature. It symbolizes growth, harmony, freshness, and fertility. Green has strong emotional correspondence with safety. Dark green is also commonly associated with money. Green has great healing power. It is the most restful color for the human eye; it can improve vision. Green suggests stability and endurance. Green, as opposed to red, means safety. Blue is the color of the sky and sea. It is often associated with depth and stability. It symbolizes trust, loyalty, wisdom, confidence, intelligence, faith, truth, and heaven.

Blue is considered beneficial to the mind and body. It slows human metabolism and produces a calming effect. Blue is strongly associated with tranquility and calmness. As opposed to emotionally warm colors like red, orange, and yellow; blue is linked to consciousness and intellect. When used together with warm colors like yellow or red, blue can create high-impact, vibrant designs.

Purple (violet) combines the stability of blue and the energy of red. Purple is associated with royalty. It symbolizes power, nobility, luxury, and ambition. It conveys wealth and extravagance. Purple is associated with wisdom, dignity, independence, creativity, mystery, and magic.

White is associated with light, goodness, innocence, purity, and virginity. It is considered to be the color of perfection. White means safety, purity, and cleanliness. As opposed to black, white usually has a positive connotation.

Black is associated with power, elegance, formality, death, evil, and mystery. Black is a mysterious color associated with fear and the unknown. It usually has a negative connotation (blacklist, black humor, 'black death'). Black denotes strength and authority; it is considered to be a very formal, elegant, and prestigious color (such as black tie and a black Mercedes). Black gives the feeling of perspective and depth, but a black background diminishes readability. Black contrasts well with bright colors. Combined with red or orange – other very powerful colors – black gives a very aggressive color scheme.

Color Harmony

Harmony is a set of colors that are pleasing to the eye, creating a sense of order and balance. The visual task of screen design requires a logical structure. Color harmony delivers visual interest, a sense of order, and creates a dynamic visual equilibrium. Inharmonious color schemes are either dull or confused. At these extremes of bad design are a bland uninteresting display or an overdone, chaotic display that repulses the viewer.

Formulas for Color Harmony

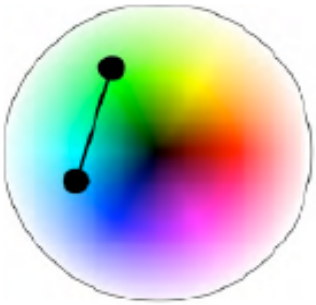
Monochromatic harmony uses variations in lightness and saturation of a single color. This scheme looks clean and elegant. Monochromatic colors go well together, producing a soothing effect.

The monochromatic scheme is very easy on the eyes, especially when using blue or green hues.

Analogous harmony uses colors that are adjacent to each other on the color wheel.
One color is used as a dominant color while others are used to enrich the scheme.

The analogous scheme is similar to the monochromatic, but offers more possibilities.
Avoid using too many hues and avoid combining warm and cool colors in this scheme.

Analogous Colors



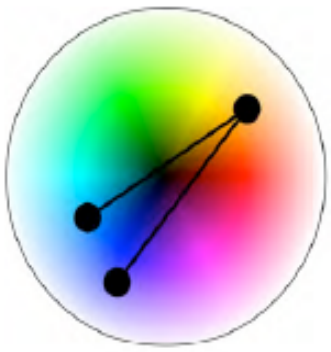
Complementary harmony consists of two colors that are opposite each other on the color wheel.
This scheme looks best when you place a warm color against a cool color, for example, red against green-blue. This scheme is intrinsically high-contrast. For best results, place cool colors against warm ones, for example, blue versus orange. If you use a warm color (red or yellow) as an accent, you can reduce the saturation the opposite cool colors to put more emphasis on the warm colors. When choosing complementary colors, fully saturated colors will offer the highest level of contrast. Choosing from tints or shades within the hue family reduces the overall contrast of the composition.

Avoid using browns or dull yellows.

Complimentary Colors

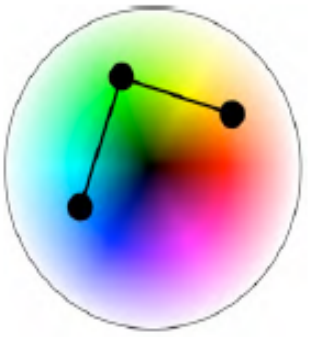
Split Complementary harmony is a variation of the standard complementary scheme. It uses a color and the two colors adjacent to its complementary.
This provides high contrast without the strong tension of the complementary scheme. Use a single warm color against a range of cool colors to put an emphasis on the warm color (red versus blues and blue-greens, or orange versus blues and blue-violets.

Split Complimentary Colors



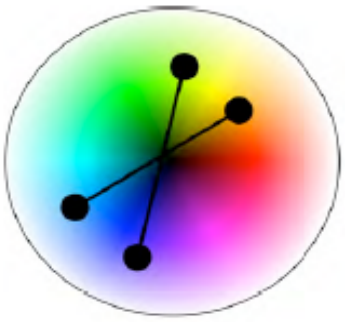
Equilateral harmony uses three colors equally spaced around the color wheel.
This scheme offers strong visual contrast while retaining harmony and color richness. The triadic scheme is not as contrasting as the complementary scheme, but it looks more balanced and harmonious. Choose one color to be used in larger amounts than others.

Equilateral Colors



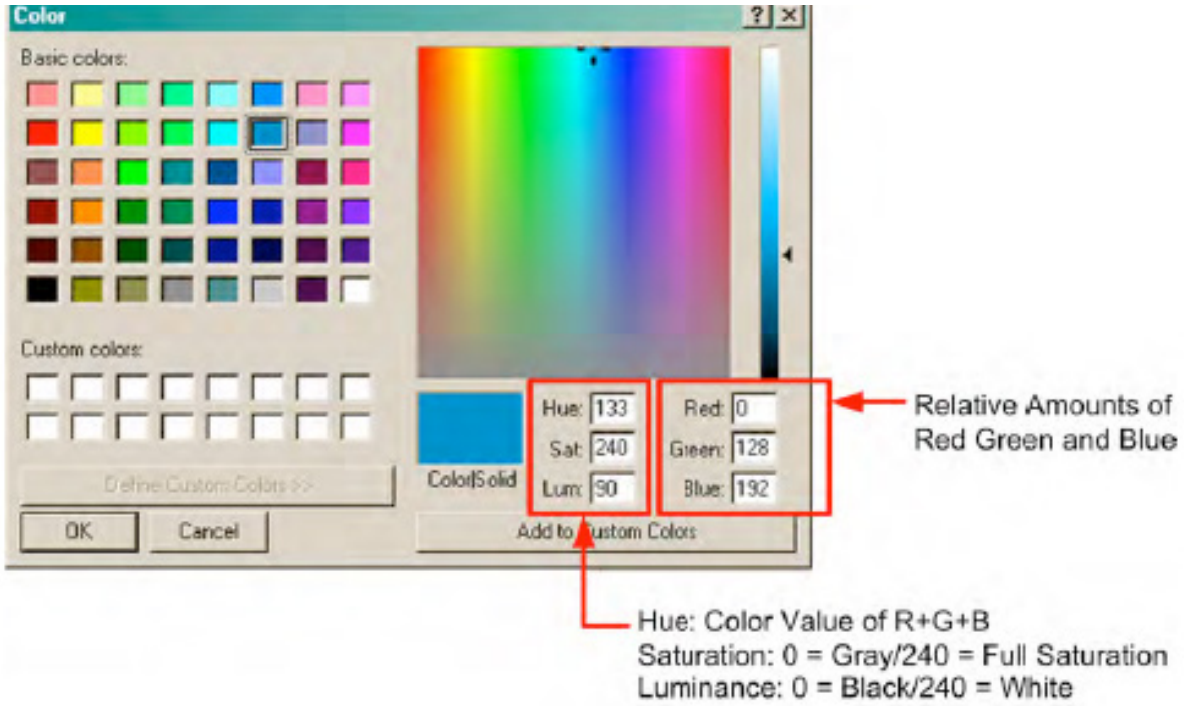
Double Complementary harmony is the most varied because it uses two complementary color pairs. This scheme can be difficult to harmonize if all four hues are used in equal amounts. If the scheme looks unbalanced, choose a color to be dominant and/or subdue (adjust the luminance) of the colors. Avoid using pure colors in equal amounts.

Double Complimentary Colors



Specifying Colors

Color properties are specified by a set of associated number values.



Color Relativity and Readability

Observing the effects colors have on each other is the starting point for understanding the relativity of color. The relationship of values, saturations and the warmth or coolness of respective hues can cause noticeable differences in our perception of color. The purple square on the left seems to recede, while the one on the right seems to advance. In addition, the one on the left appears larger (they are the same size).

NOTE: If large areas of a light hue are used, the whole screen will appear light; conversely, if large areas of dark values are used, the whole screen appears dark.

When fully saturated complements are brought together, interesting effects are noticeable such as vibrating boundaries. This may be a desirable illusion, or a problem if creating visuals that are to be read. An occurrence known as simultaneous contrast (chromostereopsis) happens when opposing colors are placed in close proximity. Text may appear to vibrate, or cast a shadow.

When creating visuals that are designed for reading, the viewer must have adequate contrast between the background and the text. Text presentations ideally offer at least an 80% contrast between figure and ground (black text on a white background is ideal). When there is not enough contrast between figure and ground, the viewer must squint to read the text, causing eye fatigue. Yellow text on a white background or blue text on a black background, are difficult to read due to the low level of contrast between figure and ground.

Appendix D: Touch Screen Typography

Typography is the arrangement, style, or general appearance of matter printed from type. To select and use the appropriate typography, there are two primary factors that the designer should consider. Legibility (Discrimination): This characteristic of an alphanumeric enables the observer to quickly and positively identify it from all other letters and characters.

Legibility depends on stroke width, form of characters, illumination, and the contrast between the characters and the background. Readability: This quality of the word or text allows for rapid recognition of a single word, word-groups, abbreviations, and symbols.

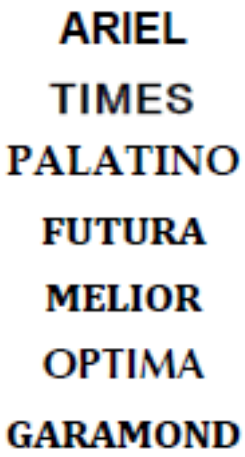
Readability depends on the spacing of individual characters, spacing of words, spacing of lines, and the ratio between characters area to background area.

Typeface (Fonts)

Typefaces or fonts refer to the style of the alphanumeric. There are over 2300 typefaces currently available. The two major groups of fonts are roman and sans serif. Roman is well known since it is used in newspapers, journals, and books. Sans serif is a contemporary font that does not include the little strokes (serifs) that project horizontally from the top or bottom of a main stroke.

Several researchers have reported that when other typographical factors are controlled, sans-serif fonts are more legible than roman. The premise behind this statement is that absence of serifs presents a more simple and clean typeface, and therefore improves the legibility of the print. Serifs disrupt character discrimination and may add uneven appearance to the shape of strokes and characters. However, it is also evident that they somewhat aid the horizontal movement of the eye along the printed line—the serifs at the top and bottom of a character create a “railroad track” for the eye to follow along the line of print.

Therefore, when using a typeface without serifs, adequate spacing between the lines of print is required to prevent the eye from ridging (slipping) to the adjoining line. The designer should safeguard against this factor as it may lead to skipping a line while reading a long list.



Among the sans-serif group there are many different fonts from which to select. A study made in 1965 compared the level of reading comprehension among five different fonts (three different sans-serifs and two fonts with serifs). A significantly higher level of comprehension was found while subjects were using a sans-serif font called Gill-Medium. This font was also ranked first in its level of character discrimination. A careful examination of Gill Medium indicates that the letters of the other sans-serif fonts are characterized by several "family resemblances." This results in similar appearance and may reduce legibility (compare the "O" and "C"). Likewise, most of the modern sansserif fonts such as Futura, Avant Garde, and Helvetica also include characters that are too similar to one another, and therefore difficult to distinguish. The sources of similarity between the characters of modern sans-serif fonts are:

- The standardized or modular appearance of the letters ("P," "R").
- The effect of mirror images between the upper and lower part of the character ("E," "B," "D").
- The use of equal radius for different letters ("G," "O," "C")

Most human factors design handbooks advocate the use of sans-serif fonts—emphasizing the characteristics of modern sans-serif fonts as clean and simple fonts. The sub-optimal effect of their over-modularity on the legibility and readability.

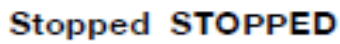
Recommendations

Sans-serif fonts are usually more legible than fonts with serifs. Avoid using a font that has characters that are too similar to one another, as this reduces the legibility of the print.

Lower-case versus Upper-case Characters

There is almost a consensus among researchers that, when other factors are controlled, lower-case characters are more legible than upper-case. An experiment was performed to determine the difference in readers' attention between upper and lower-case in newspaper headings. The results were that lower case headings were located faster than upper case headings, and lower case was read faster and ranked higher in pleasantness.

- There are several factors that contribute to the reduced legibility of uppercase words compared with lower-case:
- Most printed material that we read and use in everyday life is set in lower case.
- Readability of lower case words is superior; words set in lower-case are perceived at a greater distance, suggesting that the "total word form" and legibility of the elements is important while perceiving words set in lower-case
- The upper half of a printed line furnishes more clues to "word form".
- Upper-case characters were perceivable at a greater distance.



Recommendations

Long chunks of text should be set in lower case. If upper case is required, the first letter of the word should be made larger in order to enhance the legibility of the word.

DURING READING OF UPPER-CASE WORDS, PERCEPTION OCCURS IN A CHARACTER-BY-CHARACTER ORDER, THEREBY REDUCING THE SPEED OF READING AND READABILITY OF THE ENTIRE WORD.

The pattern or shape of a familiar word is stored in the human memory. While reading text, a matching sequence occurs between the observed word and the memory patterns stored in the brain. The more unique the patterns of the word, the easier it is to perform the matching sequence.

RESEARCH SUGGESTS THAT SUCCESSIVE LINES OF PRINTED TEXT, COMPOSING A PATTERN OF "STRIPES," MAY INDUCE DISCOMFORT AND ANOMALOUS VISUAL EFFECTS TO THE READERS.

Lower-case words consist of characters that have ascenders (the vertical stroke of "d") and descenders ("p," "q"), which contribute to the unique shape and pattern of a word. This makes the lower-case word-form appear more "characteristic." Conversely, an upper-case word appears like a rectangular box with no distinguishable contour. Another explanation of the superior legibility of lower-case text is the combination of a capital letter and lower-case characters at the beginning of a sentence and/or proper names. Research has shown that visual emphasis given to the first letter of a word significantly improves the speed of a search. This finding is true for lower-case words as well as for upper-case words combined with a larger first character. This can be useful when a designer decides to make a distinction by using typographical features such as lower- and upper-case words and still maintain discriminability and search speed.

Font Height (Type Size)

Measurement

When specifying the height of a font and spacing (both vertically and horizontally), the designer should be aware that there are several scales and methods of measurement. The traditional printer's "point" used for typesize-height equals 1/100 of an inch; however, when it is used to measure distance between lines, words, etc., a point is approximately equal to 1/72 of an inch.

Font Height versus Viewing Condition

Most of the information in the literature regarding font height is presented in graphs. These graphs usually indicate the relationship between character height, viewing distance, illumination level, stroke width, and visual acuity.

While evaluating type size for optimum reading, an experiment in 1963 reported that a 0.11 inch type size was read significantly faster than 0.10 inch. The majority of the readers judged the 0.11-inch type size as the most legible.

Stroke widths affect the ability of the eye to differentiate between the stroke of the character ("I") and the space inside the character ("E," F"). The width of a stroke is a function of height of the character. Most human factors data books recommend the use of a height-to-width ratio of 5:3.

This recommended ratio is applicable only when the document is in front of the observer (a 90 degrees angle between the line-of-sight and the document). In designing a display that is viewed from an unfavorable viewing angle (which may artificially reduce the apparent width of the character), a different height-to-width ratio (e.g., 5:4) should be considered in order to increase the actual width of the character.

The vertical and horizontal spacing between characters affects the legibility and readability of the text especially when the font height is small. Increasing the vertical spacing between lines reduces the probability of adverse visual effect from the "pattern of stripes" Research done in 1987 suggests that "judgments of the clarity of text... are critically dependent on the spacing of the lines, more so than the overall density of lettering. As a result, the clarity of text can potentially be increased at no extra cost by increasing the separation between the lines slightly and decreasing slightly the mean horizontal spacing between the centers of letters, within the limits of conventional typography". In addition, the "opening" of an appropriate vertical space between lines reduces the chance of optical bridging between adjacent lines—a critical factor for the design of any list-type display. The recommended vertical space between lines is 25-33 percent of the overall size of the font. The horizontal space between characters should not be less than one stroke width. As for word spacing, the gap between characters should be large enough to allow grouping of words. This is achieved when the word space

Line Length

Line length is an important factor because the designer will always try to minimize the size to fit in a button or small space.

Face, Italic, Bold and Underline

Several experiments discuss the effects of different typefaces on legibility. In one experiment, an italic face was read 2.7 percent slower than roman lower-case (with an equal “x”- height). Furthermore, 96% of the 224 subjects who participated in this study judged that italic is less legible than a regular roman font. Bold face was read at the same reading speed as lower-case text. However, the majority of the subjects (70%) commented about the unpleasantness of the text as compared to plain roman font. Results of another experiment indicated, “that bold and medium typefaces do not differ in readability, even under low illumination”; suggesting that there is no apparent advantage in long chunks of text in bold face. Nevertheless, bold face can be safely and advantageously used for contrast and emphasis. Although faces can highlight a specific item, overuse of this typographical technique can be inefficient. Employing too many faces for contrast, emphasis, and attention seeking may be confusing and an dramatically reduce the legibility, and readability.

Contrast

Crestron recommends the use of dark characters over a light background for normal illumination conditions. However, when the observer must maintain a dark adaption condition (a darkened home theater environment for example), Crestron recommends a light character over a dark background.

Color Coding

A character and its background may differ in the amount of light they reflect and color. When viewed from a short distance, the visual difference between the character and background is better reinforced by using large luminance differences than by employing large chromatic (color) differences. In other words, the contrast is more important than color differences in determining visibility of the characters. For example, red and blue have considerable color contrast; yet can have a very small luminance contrast. Yellow characters over black and dark blue over white are probably the best choices of color contrast. In several experiments to determine the effect of color contrast on legibility to test the perception of different colored numerals at a glance, black characters over yellow background showed the best results.

Using Dark Characteristics Over Color Background

- The reflection percentage of the background should be at least 70 percent.
- The luminance ratio between the character and the background should be about 1:8.
- The type size should be 0.10 inch or greater.

The human peripheral vision is limited in color sensitivity. Some colors are recognized at a greater angle away from the line-of-sight than others. Colors have a psychological effect on human beings, mainly because we associate certain colors with past experiences. Some colors convey the feeling of warmth, while others appear cold. The color red is usually associated with danger, green with normal, and amber with caution; and so are the colors of indicators. For example, black characters over a yellow background, is associated with caution, diagonal yellow and black stripes are used in many military cockpits to indicate caution conditions.

List of Typography Design Recommendations

The designer, based on the type, usage, and criticality, should carefully evaluate each of the following recommendations.

- Sans-serif fonts are usually more legible than fonts with serifs.
- Avoid using a font that has characters that are too similar to one another, as this will reduce the legibility of the print.
- Long chunks of text should be set in lower case.
- If upper case is required, the first letter of the word should be made larger in order to enhance the legibility of the word. When specifying font height, or accessing graphs to determine the size of a lower-case character, the distinction between “x” height and overall size should be made.
- As a general recommendation, the “x” height of a font used for important flightdeck documentation should not be below 0.10 inch.
- The recommended height-to-width ratio of a font that is viewed in front of the observer is 5:3.
- The vertical spacing between lines should not be smaller than 25-33% of the overall size of the font.
- The horizontal spacing between characters should be 25% of the overall size and not less than one stroke width.
- Avoid using long strings of text set in italics.
- Use primarily one or two typefaces for emphasis.
- Avoid using black over dark red, green, and blue.

Acknowledgements

The original work for the typography recommendations was NASA CONTRACTOR REPORT # 177605 “ON THE TYPOGRAPHY OF FLIGHT-DECK DOCUMENTATION” by ASAF DEGANI, and supported by NASA research grant No. NCC2-327 from the Ames Research Center to the San Jose State University and grant No. NCC2-377 to the University of Miami.

Further Inquiries

If there are questions after reviewing this guide, please take advantage of Crestron Sales Support Services by calling Crestron corporate headquarters at 1-888-CRESTRON (1-888-273-7876).

The online help section of the Crestron website provides answers to questions about Crestron products. First-time users need to establish a user account to fully benefit from all available features.

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Refer to the listing of Crestron worldwide offices on the Crestron Web site (www.crestron.com/offices) for assistance within a particular geographic region.

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